

# AVIATION AND AERONAUTICAL ENGINEERING



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AUGUST  
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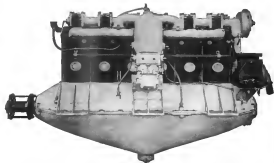
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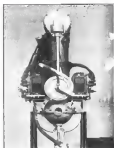
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AUGUST 15, 1917

# AVIATION AND AERONAUTICAL ENGINEERING

VOL. III. NO. 2

*Member of the Associated Business Papers, Inc.*

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# AVIATION

AND  
AERONAUTICAL ENGINEERING

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GEORGE NEWBOLD

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August 15, 1917

No. 2

**T**HE problem confronting the small constructor of airplanes at the present time is serious and one likely to become increasingly difficult unless solved by the Aircraft Production Board in a prompt and satisfactory manner.

The difficulties which the small constructor has encountered in the past have recently been further aggravated by the shifting of official authority which the pieces of expansion and reorganization of the United States Air Service has made an unavoidable necessity. Prior to the War, the Aviation Section of the Army endeavored to assist, within the modest appropriations granted it by Congress, the development of all available types of military and service aircraft. This policy encouraged the design, construction, and experimentation of many airplanes for military and naval purposes.

When the formulation of a war program was undertaken by the Aircraft Production Board, the requirements of our Air Services were found to have increased to such proportions that the available sources of supply of airplanes and engines would prove insufficient for the purpose. As a consequence large manufacturing concerns that had no previous experience in aircraft construction but possessed the skilled labor and the machinery required for quantity production had to be called upon so as to make possible the rapid construction of a big air fleet.

This policy would be completely satisfactory from the viewpoint of rapid production, if it took mere into account the interests of the small manufacturer whose experience and expenditures entitle him to consideration. Large sources of supply and strict adherence to standard designs are obviously desirable and even indispensable for rapid production of aircraft. This is especially true where a type of aircraft is required which has not analogous radical alterations during the war, that is, testing and reconnaissance machines.

But where standardization is likely to defeat its own purpose it is the construction of present airplanes whose performances are bettered, now by the Allies, now by the Germans, from month to month, so that an airplane of five months' age is generally considered obsolete after only a few months of service. To improve constantly the speed and climb as well as the armament of present airplanes the brains of our cleverest mechanical engineers and draftsmen should permanently be kept engaged on the problem; but to do this an airplane manufacturer needs a certain amount of steady orders which will enable him to run his factory if not with profit, at least with no loss.

It is understood that for the present the Aircraft Pro-

duction Board believes in giving its preference orders to organizations which can make at least 600 machines per year, or about 12 per week. While there seems to be no desire or intention to stifle competition or favor the big sources of supply to the detriment of the small ones, the impression is created that there will be a period, however, during which chief attention will be paid to the large manufacturer in order to establish a certain amount of foundation work, so that quite some time may elapse before the small constructor will have a fair chance of success.

If a limited number of trial orders, spread over a fair period, could be given to responsible concerns who have not the facilities of large manufacturers, it would doubtless result in creating an incentive which should have a decidedly favorable effect on the development of the American aircraft industry and the successful pursuit of the war.

## The Handley Page of the Air

In this issue our readers will find a description of the Handley Page twin tractor biplane, which is propelled by two 370 horsepower engines, and carries three machine guns and eight bombs of 150 pounds each. The biplane is equipped with three 200 horsepower engines has an equal gun and bombing capacity. The new German machine, a biplane which bears evident traces of alterations inspired by the Handley Page design, and is equipped with two 250 horsepower Mercedes engines, seems equally well equipped from a fighting standpoint. It carries three machine guns, one of which can fire down through the body, enabling the crew to meet an attack from an opponent who would otherwise be masked by the tail surfaces.

We have been accustomed to theoretical discussions of the bearing use of airplanes. It is possible to demonstrate theoretically that, given machines of exactly similar design, if all dimensions increase in the same ratio the bending moments increase more rapidly than the resisting moments, so that a point is reached where further growth is impossible. But these machines are not of similar geometrical design. Thus in the Handley Page constructor the wing rib construction breaks away from the standard lightened web construction of the small machine, and develops boldly a lattice girder construction, with the obvious advantages of a calculated and lighter rib structure. Similar improvements are probably possible at other points. Steel may be used in large machines where a paper thickness precludes its use in smaller airplanes. Thus the theoretical maximum size disappears.

# Logarithmic Diagram for Selecting Propellers

By G. Effel

Abstracted from *L'Aerophile* by Thomas E. Balchmore

This article relates to a re-interpretation of the logarithmic propeller chart for eight of the series for which the results were published in "Nouvelles Conclusions sur le Rendement de l'Air et l'Aviation," 1914. The aim series of tests were recomputed by the fact that the determination of true previously made were not sufficiently exact. Two direct methods for finding the true data now have been devised, and can be used to check against each other.

The new logarithmic diagram is given in Fig. 1, as well as drawings of the eight propellers tested. For each one,  $\log \frac{P_{sh}}{D^2}$  is plotted as a function of  $\log \frac{V}{N}$ , and the various propeller efficiencies obtained are marked on the curve at the propeller point.

The diagram permits us to choose the propeller which best suits the required conditions, knowing the velocity of translation,  $V$ , the power  $P_{sh}$  of the engine, and the r.p.m. of the propeller, or the velocity, the power, and the diameter  $D$  of the propeller.

To make the choice, we proceed as follows: draw a broken line starting from the origin,  $O$ , and having segments equal in length to the values of  $D$ , r.p.m., etc., as suggested from the points  $O$  or as the various axes of those quantities.

For example, the full broken line shows that in this case  $V = 90$  m.p.h.,  $P_{sh} = 150$  h.p., and  $N = 1000$  r.p.m. To this broken line is added a segment parallel to the axis of diameters

The segment cut off by the curve of the propeller chosen, but off from  $O$  on the axis of diameter, measures the diameter of a propeller of this type which will be required to fulfill the given conditions, and the point of intersection with the propeller curve gives, by interpolation between the values on the curve, the propeller efficiency.

Selecting propellers Nos. 11, 24, and 8 to serve as examples we have the following values for required diameters:

Propeller No.	11	24	8
Diameter (ft.)	6.4	6.9	4.7
Efficiency (%)	72	74	66

The conditions given for the problem, the solution of which is represented by the dashed broken line are:  $V = 90$  m.p.h.,  $P_{sh} = 150$  h.p., and  $N = 1000$  r.p.m. We then find the following values for the necessary r.p.m. for propellers Nos. 11, 24, and 8—

Propeller No.	11	24	8
R.p.m.	407	299	367
Efficiency (%)	72	74	66

From such a table as this it is easy to select the type of propeller which will best suit the need, and then to proceed to the design without loss of time in preliminary work.

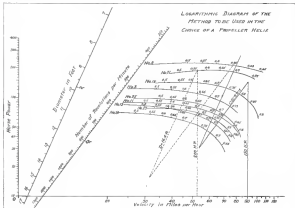
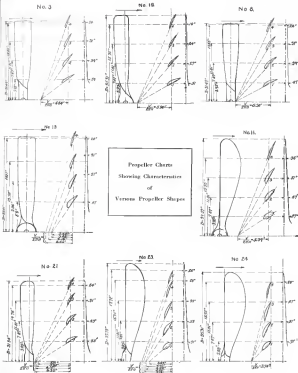


Fig. 1

August 15, 1917

AVIATION

95



# On the Value and Use of the Large Airplane

By F. Handley Page

The endeavor of the present article is to show how by the use of large airplanes America can make her weight felt in the war to a much greater extent than by equipment of any other sort.

It is a well known fact that the large airplane is an absolute necessity whenever great distances have to be traversed or large objects be carried. The high speed type of machine, with the very small masses of weight available for carrying useful loads, is of little value except for short distance fighting and high speed performance.

When great loads are to be carried or long distances be flown, one must resort to a somewhat slower machine, flying at about 100 miles per hour (instead of the 150 and more miles per hour which the speed scouts attain), and capable of carrying 30 lb. per h.p., compared with the 7 or 8 lb. of the high speed machine.

To fully understand the diverse problems which confront the employment of the military airplane it is necessary to consider the machines prevailing at present on the Western Front. These great armies, annihilated by trench warfare, are separated from one another by very short distances, so that an hour or two's flight at the outside with daylight in the morning tells the whole of the enemy's defense works, depots, communication lines, and so forth. The carrying out of this reconnaissance work obviously entails considerable risk to the reconnoitering machine, and for the purpose of its protection it is essential that fighters of one type or another should accompany it. In addition to this, fighters go into action to keep away from the friendly lines every fighting and reconnaissance machine.

It is particularly worth attention that all these machines operate over extremely short distances only. The fighters, in particular, carry only light loads, so that their requirements are easily and easily met by the employment of small high speed scouts, which, owing to their great maneuverability, are able to fight at close quarters, and thus overcome the handicap of accurate gas fire, which is a conspicuous feature of present day aerial gunnery.

Such are then the requirements that must be met by an

aerial force working in conjunction with an army engaged in trench warfare. In view of the very rapid development of the airplane, it is, however, quite possible that the whole present system of warfare may undergo, in the near future, extensive alterations. The advent of the large, multi-engine airplane appears in particular to forecast such a change; it seems, therefore, worth our while to examine in what way and to what extent the large airplane differs from the other small type of single-engine machine.

The first quality we notice is the ability to fly considerable distances with heavy loads, and whereas in large scale warfare it is essential to the rear, long distances may be traversed without great strain upon the equipment.

There is, however, a further quality which any multi-engine machine possesses, namely, that of adapting when and where it chooses, thus eliminating the risk of a forced landing due to engine failure. If we recall at the present time reasons from the airplane's characteristics the feeling of security, we should at once advance its ability to a great extent. The multi-engine machine appears to well fulfill this requirement, for it is the engine that provides, more than anything else, at the present time, that element of security which makes a more extended use of the airplane predominant.

When we are unable to build our engine very heavy, as in the case of locomotives and automobiles, and so increase their reliability, we can but resort to a system of multi-engines to provide against breakdowns and on present the machine from landing on unsuitable ground.

The failure of one engine should not prevent the machine from flying home with the remainder of the power plant, so, to be sure, the speed would be reduced, but, on the other hand, with one engine out and, more power would become available, so that a corresponding greater distance could be covered at reduced speed.

A further advantage may be found in the relative simplicity of the landing device. Landing gear of the present design is mainly made necessary by the complexity of landing on unsuitable ground. A multi-engine machine being able to choose its landing ground, the cost of landing would

also be greatly reduced, because, instead of providing for a great number of landings at short distances from one another as has recently been suggested for commercial machines, it would be quite sufficient to establish aerodromes only at such points where reasons of expediency required.

These considerations are also likely to alter current ideas in regard to the use of the airplane. Single-engine, whether of the land type, long-distance, or whether it is an airplane of the same type and power chiefly wing in the much greater weight and resistance of the land or float as compared with the elements of the airplane. If, however, we can discount the complexity of a forced landing, we can get as well do away with the land and float and employ ordinary airplanes for aerial service, since the system of multi-engines saves the machine against being forced to alight on the sea.

It is evident that we should be able to strike a blow at the very heart of the enemy's defenses.

No gas gun, at the present time, fire the distance, or deliver so much explosive at a given spot as the airplane, and but few guns are able to produce the same effect over much greater distances.

Such an offensive, which appears quite feasible in view of the present development of the airplane, could not adequately be developed on the Western Front, partly for the lack of adequate machines and partly for the present need of the armies for communication and fighting airplanes. It is obvious that until a sufficient number of such machines be made available it is useless to dream of proceeding or attempting to provide airplanes for a great aerial offensive.

This is then a question that rests upon the productive capacity of the aircraft factories. Supposing the Allied air-



Large View of One Engine and of the Cabin of the Handley Page Bomber

A discussion of the large airplane naturally leads one to consider how the type of machine could be made particularly suitable to the needs of the United States at the present war. The problem may be dealt with under two headings:

1. Cooperation with the Allies on the Western Front.
  2. Independent action.
- The present requirements of the Western Front, so far as the cooperation of the aviation service with an attacking army is concerned, have briefly been touched upon above. There again, however, a far greater and wider sphere for the airplane if one proceeds to consider a real aerial offensive. While it is true that a number of bombing machines have been developed in the past, these airplanes never extended over great distances, and the load of bombs that has been dropped on the enemy's rear has been, relatively speaking, very limited.

With the use of large airplanes of multi-engine type the situation would be entirely altered. If we suppose a fleet of several hundred of such machines, each carrying one, two, or even three tons of bombs, proceeding after a flight of many hundred miles into the very heart of the enemy country and dropping with high explosives munitions which are essential to the provisioning of the people and the maintaining of the armies, it will be

pat of airplanes could be enormously increased in the near future, then the immediate needs of the armies at the 1918 could be more than met, and the surplus of production be turned into supplying machines for an independent aerial offensive.

Such an extension may readily become an accomplished fact under America's entry in the war, for this country possesses all the requirements needed for the maintenance of such an offensive. The well-known American ability for mass production, as well as the large number of refineries for operations that is to be found in the United States, would undoubtedly make an ideal combination for carrying a great bombing campaign against Germany. Such an offensive could be carried out by a large fleet of American airplanes operating as a separate unit, since its work would be separate, too, from the immediate needs of the armies in the field.

I shall endeavor to describe how such an airplane offensive could be carried out and what actions there may take place. To begin with, it is essential that it be carried out by night, for, given adequate instruments, a place can be reached by night just as easily as in daytime, while on the other hand there is less likelihood of being attacked by anti-aircraft fire or hostile airplanes.

At the base a hundred of these large machines are stacked



Three-Quarter Front View of the Handley Page Airplane (After British Patents)



performance were almost strongly defeated with anti-aircraft guns, as good results are obtained with guns up to 14,000 ft. It is however quite legitimate to utilize this type for day bombing of objectives not strongly defended (or well protected) that is, towns and all towns in Germany behind the Rhine, provided these machines are exceptionally heavily armed against aircraft attack.

To be properly armed in this sense, at least three twin machine guns would have to be carried and probably four twin machine guns, which would require a total crew of six men. Transportation of weapons and loads presented will show that no difficulty would be experienced in carrying such armament into effect. It should be noted also that the general policy is to accomplish

bombing machines with gun machines if possible, making the latter of same type as the former.

#### NOTABLE PERFORMANCES

Among the most notable performances of the Blenheim, Page twin-engine biplane may be mentioned (1) an altitude flight of 7,500 ft. with twenty-two men aboard; (2) an altitude flight of 12,000 ft. with full load, 20,000 ft. having reached a 25 minutes (this flight was made with a Handouts engine model); (3) a flight from London to Paris in 2 hours 20 minutes (this and best time, in course, 7 hours 30 minutes); (4) a flight from London to Rome with a crew of five in 2 hours total flying time.



REAR VIEW OF BOMB WITH BLIND CIRCLE FORMER BLISS

Official British Photograph

## Disturbing Bodies on Wing Surfaces

By Alexander Klemin

On many recent examples of airplane construction, we find disturbing bodies such as radiators and fuel tanks below and above the wings. It becomes important to determine where such obstructions shall be placed from an aerodynamic point of view, so that they will least affect the lift of a wing and impose least load resistance on a machine. Experiments to determine these points were carried out at the Massachusetts Institute of Technology.

An R. A. F. F. wing section was employed of chord 3 in and span 18 in., with an obstruction of dimensions 2 x 1/2 x 1/2 in. the tests being conducted at a wind speed of 50 m.p.h. If we imagine the wing to be 1/2 in. thick, the dimensions of the obstruction would be 4 ft. x 9 ft. x 9 ft. with a projected area to the wind of 3 ft., which would be roughly comparable with the dimensions of a locomotive radiator. The tests were carried out with the center of the block placed at 1/2 of the chord from the leading and trailing edges, on the upper and lower surfaces at the center section of the wing.

As experiments at the National Physical Laboratory have shown, it is the center section of a wing which develops the greatest lift and efficiency, both lift and L/D falling off progressively towards the tip. If we consider also a typical pressure diagram as shown in the figure, the possibility of important losses becomes apparent. Thus, we are concerned with qualitative results only, the actual lift and drag on the model have been plotted in the curves. The lift in position A is considerably less throughout the working range of angles than in any other arrangement.

If we consider that the block is then placed at that point on the wing where the maximum section pressure is de-

veloped, we can see that this loss is left is to be reasonably expected. In other positions the loss is left is not appreciable, and when as at C the block is placed on the lower side towards the rear trailing edge, the lift is actually increased, the obstruction apparently increases the pressure on the lower face, of course at the expense of some additional drag.

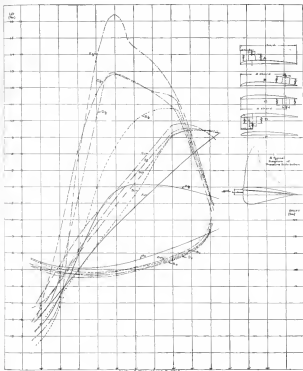
The drag and L/D are poor for the combination A and B on the upper surface of the wing. D and C have similar values of L/D than the wing alone, but then the obstruction is a real one, which would produce drag wherever it was placed on the machine.

It is also noteworthy that the increase in drag of the combination C over the wing alone is so small. If the block were treated as a flat plate normal to the wind, with a coefficient  $K = 0.028$  or 1 lb. ft./sq. inch, its resistance would amount to 0.032 lb.

At B the drag of the wing alone is 0.030 lb., that of combination A is 0.040, or a difference of 0.010 practically equivalent to the flat plate figure.

At the same angle the difference between the drag coefficients of combination C and the 0.030 of the wing alone is only 0.006. Something like 90 per cent decrease in drag is therefore gained at small angles by placing the block at C as compared with the drag of the block placed either at A, or anywhere else on the machine where it would not be sheltered by the wing. At larger angles this gain would also increase a high percentage.

It would seem, therefore, to place an obstruction of this nature on the lower surface of the wing towards the trailing edge rather than anywhere else on the wing.



Disturbing Bodies on Wing Surfaces



It will be readily recognized that the ventilation must be proportioned and arranged to carry out heavy wet air. The ventilation is therefore downward, and a damp air accumulation put in provided below the stock. From this pit is a series of horizontal ducts terminating in vertical stacks, each stack being provided with heating pipes to assist the flow of damp heavy air upward.

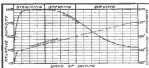


Fig. 1

The cycle of steaming, steaming (cooling) and drying is given on the chart shown in Fig. 1, although the gradations from step to step are graded and not abrupt. The "up" "down" (steaming and steaming) effect of the high humidity is immediately important, and all changes in temperature and humidity should be gradual and never sudden.

The drying method, which was originally developed for efficient and speedy drying, possesses two other important features, that are worth more than passing notice.

The old fashioned method of drying, which was an approx-



Fig. 2

sation of drier heat only, with a very low humidity, either through steam coils, hot water, or both, had a tendency to dry only the surface of the lumber and underlay the water so interior of the board, making an end cross-section look something like that shown in Fig. 3.



Fig. 3



Fig. 4

Showing End Section Quarter Refined Board, Intermediate. Above How Lumber May Be "BLOW-DRYING" and "BLOW-DRYING" in Internal Strain, and How Lumber Can Be Dried Without Internal Strain.

The depth of color indicating the degree of wetness, a surface moisture content of 5 per cent, and a coarse moisture content of 10 per cent are not unusual, making an average of 7 per cent moisture content.

In the vapor type of kiln, all boards will be evenly dried from surface to center, because the surface is kept wet to the high humidity, while the center moisture is coming out. If the board, while placed in the vapor kiln are entirely air dried, and have a surface drier than the interior, the preliminary steaming will tend to equalize the moisture in different boards. The uniform condition of wetness or dryness in boards, eliminates the vapor kiln at all stages of drying, prevents internal stresses, and the consequent injury to lumber by stresses indicated by warp, twist, and hollow bore, and the damage that comes from fiber cleavage or separation, such as checking and incrusting.

Another characteristic of vapor drying which is of great



Fig. 5



Fig. 6

Showing End Section of Plain Refined Lumber, Intermediate. How It May Be "BLOW-DRYING" and "BLOW-DRYING" and How It Can Be Dried Without Internal Strain.

value in the phenomena of the lumber. Because lumber dry by heat only shrinks it warps, while steaming it dry retains most of its thickness. The baked potato is always abnormal and the boiled or steamed potato is always plump. If is not, at curves, possible to dry lumber without any shrinkage, as the withdrawal of so much moisture will inevitably mean some loss of dimensions.

The vapor process will, however, reduce the shrinkage to a minimum, so any case far below the baking process.



Fig. 7

Showing "BLOW-DRYING" Dried to Internal Strain in Upper Strain.

LAURENCE'S NOTE:—This article is a description of the cycle and one type of drying apparatus of which some 3,000 installations have been made. The state in the condition and condition of the lumber, and the quality of the lumber, and put dry it by a method that is immediately economical and feasible. The United States and foreign patents on the type of kiln described are owned by the Grand Rapids Veneer Works, Grand Rapids, Michigan.

## The Controlled Unsaturated Atmosphere Expansion Method of Lumber Drying

By A. J. Henry  
of the Cedar Dry Kiln Co.

The conditioning or seasoning of woods, such as spruce, ash, oak, mahogany and pine, that go into unsaturated construction, is a comparatively new problem in lumber drying.

Properly seasoned spruce, the most important lumber used, can no longer be obtained in sufficient quantities of the required grades. Therefore, in order to meet the demands of present day production, green lumber must be seasoned artificially, which, if properly done, produces a better dried stock than can possibly result from natural air drying.

The outside commonly used for kiln drying (lumber are not suitable for airplane species. Lumber used in the manufacture of airplanes, etc., must be "season dry." Usually all the moisture and a fair percentage of the sap are taken out, as the element of strength is not a large consideration. For example, the outside bed of an after disk is of about 2 in. in thickness, it led 15 in. thick would give sufficient strength for any use, but the heavy moisture 2-in. bed is used as a matter of appearance and design.

In the case of airplane species, strength with lightness at the first consideration. The part must not be what is known as "lower dry," yet the moisture must be evaporated while the sap or life of the wood is retained. The United States, as well as the Allied Governments, realize this, and their requirements and tests are very rigid.

There are two important kinds used in the construction,



Fig. 8

lumber and construction. The special conditions must be maintained evenly and continuously throughout the seasoning process.

These requirements of a comparatively low temperature, in order to preserve the sap, make it practically impossible for the ordinary type of lumber kiln, to obtain the high humidity within a reasonable length of time.

In the Cedar kiln the side walls and roof are made of a special fabric, the weave of which is of the coarsest possible to retain heat, and at the same time allow proper ventilation. The side walls are arranged to raise and lower so that the heating and unloading can be done continuously from any side desired. They also assist, in a very important manner, in distributing the moisture evenly over all parts of the kiln.

Inside the kiln are placed specially constructed heating coils which are operated by low pressure steam and the temperature is automatically controlled by any given device.

The humidity adjustment apparatus is arranged to work in accordance with the heating coils. In the same space, also working with the heating coils, are placed small water tanks which increase the circulation and keep an even humidity and temperature throughout the kiln. By this means the conditions are moved through the lumber piles in them parallel to the kiln floor.

It has been proved by practical experiments, that spruce can be less seasoned by expansion of its moisture, rather than by its absorption from the surface, by dry hot air. The expansion method puts no stress on the surface, and the pine does

through evenly, if the conditions are right for the kind of seasoning.

By using a rapid circulation of heated air of a high relative humidity, the slightest excess of moisture over that of the air, thrown off by the act of heating the lumber, is carried away without reducing to a dangerous degree the moisture content of the surface. A continuous drying of this sort produces better lumber because the sap has not been affected, except to remove the moisture down to the desired point.

The action is directly opposed to the method of opening the



Fig. 9

surface pores with heat and moisture, and then decreasing the humidity, thus having the air act as a blower, whisking the surface moisture, and that moisture near the surface. The "blower method" tends to keep the surface always drier than the center of the lumber, and as the lumber approaches the required dryness, there is always an uneven distribution of the remaining moisture. This is not as serious a defect in 1 in. lumber, but in 2 in., 3 in. and up to 6 in. stock the difference is very great, and the drying must be done very slowly.



Fig. 10

In heavy stock, such as airplane beams, the difficulty is increased by the thickness. The unevenness of conductivity of heat of fairly dry lumber makes it necessary actually to prevent surface drying until the pores have been heated through. We prefer to use "dead green" lumber as the moisture acts as a condenser, and the pores heat up more evenly, and the drying is quite as quick as would be the case with partially seasoned lumber.

Spruce beam stock 3 in. in cross section can be seasoned through 40 per cent moisture content down to 18 to 20 per cent in twelve days, without losing its strength appreciably more than is done by natural air seasoning.

# Airship Suspension Systems\*

By "E. R.ingham"

The chief points to be borne in mind in designing the suspension system of an airship are—

- (1) The distribution of the weight over as wide an area of the envelope as possible.
- (2) The reduction of head resistance.
- (3) The reduction of aerial drag or head room.
- (4) It is imperative to maintain the various struts which have been made to meet these requirements.

## General Roping Systems

In a spherical balloon the basket is hung from a net encircling the top half of the balloon, and this method was adopted for skimming the sea of some of the earlier types of airship from the Montauk station. As, however, it is a semi-rigid or semi-rigid airship, with which types about we are concerned at the moment, all the stresses have to be met by the pressure of the gas and the strength of the fabric, the method has the disadvantage of putting the top surface of the envelope in compression, though it was many years before this fact was fully appreciated.

A modification of the system was, indeed, adopted in the first British airship, the "Nella Secundera," which was provided with broad bands of fabric carried over the top surface of the envelope, the gas being shung from the extremities of these bands which constituted at about the "equatorial" position to employ a ballooning term—on a level with the longitudinal axis of the airship. In the majority of modern airships, therefore, the point of suspension will be found to be at or about the longitudinal axis, the airship being suspended through the top of the envelope in the various struts which support it.

## "Rigging Band" Suspension

The most usual method, undoubtedly, is the employment of a "rigging band," which consists of a strip of fabric—generally two or three—yards wide and made around the envelope either at the circumference or near the bottom surface. The latter method has the advantage of reducing the size of the rigging band and so on weight.

It was the first to attract attention, this method the present writer is unable to say with exactitude, as adaptations of early airships are in the majority of cases so numerous and change so rapid that it is difficult to say with certainty whether the rigging band is actually stuck to the envelope or whether it is merely the termination of a net or fabric encircling the top half of the envelope. It was, at any rate, used in the early French, German, and British airships. More definite information on this point would be interesting. The "Nella Secundera" in its later form had a rigging band, while retaining the fabric or webbing bands for the landing gear.

## THE FRENCH SYSTEM

In 1907 (British Patent No. 4915), the German Patent Airship Co. (Leit-Fahrzeug-Gesellschaft) of Hildesheim is credited a system of "temporary bands" in conjunction with



FIG. 1

a rigging band, which has been enclosed in all these airships both subsequently. This consists in carrying fabric bands transversely around the envelope from the rigging band on each side, along the line of maximum stress, instead of encircling the envelope as in the older superficially similar method (Fig. 2).

Another device in airships recently employed is a band—fabric, sufficiently in the airship, from which the car was suspended.

\*From *Aviation*, London.

## THE OTHER SIDE MATTER

The only other system of external roping which has been adopted of recent years is that of suspending with the rigging band and attaching the rigging guys direct to the envelope by means of "resistors." This is obviously only applicable to envelopes of very small size, as it involves a considerable head stress on small portions of the total surface of the envelope.

## Types of Cars

Up to the present we have dealt with the method of distributing the ultimate stress of the weight of the car



FIG. 2

over the surface of the envelope on (or on the attachment to the envelope is concerned, and it is now proposed to deal with what may be described as the other end of the problem—the size of the car, and the resulting angles of the rigging guys.

It will be readily appreciated that the longer the car the more evenly the weight is distributed and the more uniform the rigging guys will be, and a very small car will show that a long one also shows of closer rigging to the envelope, because, if a short one is employed close to the envelope, it is impossible to carry the rope to the more distant points of the envelope, except at a prohibitive cost.

A long car, however, involves increased head resistance, increased weight—which is counteracted by the fact that the



FIG. 3

car must be of greater draughtsmanship strength to meet the increased stresses produced by the length and weight of "nose."

This difficulty is put over to the rear end which by employing a rigid, aerodynamic nose under the envelope or, in the case of the "Nella," and another to project forward, and following the curvature of the envelope, from which the car is suspended instead of direct from the envelope itself.

This is a compromise which is now generally adopted, though it still entails at a somewhat exaggerated form in the case of the majority of British airships, which will be dealt with later.

The semi-rigid system has always served to the better a somewhat outside because of the question, as it involves most of the disadvantages of the long car and rigid nose without possessing any real solution of the problem.

The semi-rigid system has always served to the better a somewhat outside because of the question, as it involves most of the disadvantages of the long car and rigid nose without possessing any real solution of the problem.

## THE FRENCH SYSTEM

The United States No. 8, type airships adopted the rigging band, but have what appeared to be a defect in the actual arrangement of the guys. There are five rigging guys on each side of the car, and of these all, except those at the bow

and stern, are dropped perpendicularly from the envelope (Fig. 3). This leaves the forward guy to bear somewhat of the whole weight of the car when the ship is standing, which could easily be remedied by raising guys B and J and K as in Fig. 4. Similarly, the rear guy (L) should be raised horizontally, as well as end struts, to prevent the tendency of the car to roll. The importance of both these points is emphasized in a patent (No. 146,872) taken out by a "Nella" in 1902.

## Internal Roping Systems

### THE VERDINE SYSTEM

Internal roping has the disadvantage of necessarily increasing head resistance, and several attempts have been made to devise a satisfactory system of air suspension in which the suspension are for the greater part inside the envelope.

The first known of these is that adopted in the "Nella Secundera," in 1907 (British Patent No. 4915), and is shown in Fig. 5. It is a system of internal roping, in which the suspension are for the greater part inside the envelope. The first known of these is that adopted in the "Nella Secundera," in 1907 (British Patent No. 4915), and is shown in Fig. 5. It is a system of internal roping, in which the suspension are for the greater part inside the envelope.



FIG. 4

do shape of the envelope. Along each of the ribs formed by the division between the top and side ribs cables are inserted, which are attached fabric suspension straps. At frequent intervals along these straps suspension ropes (which are made of such as are attached). The suspension ropes from both sides and over the bottom of the envelope, and are continued in a cable which comes out through the bottom of the envelope at the extremity of the two main cables. There are also suspension ropes from which the car is hung, a set of the suspension ropes being fixed to each. Fig. 6 gives a diagrammatic sketch of the system.

## THE VERDINE SYSTEM

The Italian engineer Verdone has devised a successful system (described in British Patent No. 150,688 of 1914), in which the load is enclosed in the water case of the airship, and the suspension are internal. The



FIG. 5

A diagrammatic cross-sectional view is given in Fig. 5.

## THE VERDINE SYSTEM

The Verdone airship (British Patent No. 15,068 of 1914), which is also an Italian design, is similar to the Verdone in that both employ a kind but the internal suspension system is more mechanical of the Verdone-Verdone than of the Verdone.

The envelope is almost spherical in cross-section, but has a small top lobe, at the junction of which are attached fabric diaphragms, which meet near the top of the envelope, instead of at the bottom as in the Verdone. To the point where these diaphragms are attached from the suspension ropes are attached, from which a triangular load is suspended (Fig. 6).

It will be noticed that in all the three of the internal roping systems described the weight is taken on the top surface of the envelope, which has various small struts, which are attached to the envelope in the top surface. As has already been pointed out, a curved airship is entirely dependent on the pressure of the gas for the maintenance of shape, so that if the pressure is lost, the airship will usually about 15 to 20 cm. of water) deformation will take place.

Now in an airship where the weight of the car is borne by the top surface of the envelope the effect of loss of pressure will merely be— at an early, to add more— that the envelope will lose its spherical shape in proportion and will tend to become oval, a feature which will not be followed in later airship consequences.

In the case of an internally rigged ship, such as the Verdone, however, the envelope is enabled to adjust itself to the changed conditions in this way and some other deformation must take place. The bulk of the weight being taken by the envelope portion of the envelope, it is clear that relief will take place at the ribs, which will tend to bow. The effect of this will be that the airship will "break its ribs" and become considerably elongated, while at the same time a considerable extra strain will be put on the forward and after guys, which will either carry away or pull through the bottom of the envelope.

In the Verdone system, where a kind is provided along practically the whole length of the envelope, this disadvantage is not present with such serious consequences.

Within the limits of this article it has been impossible to do more than give a general sketch of the different suspension systems employed in airship design, and no attempt has been made to go into the details of any of the different systems, which are much more than a sketch, but it is sufficient to point out a number of the general principles of the more important types of airship which have been mentioned in this article, and perhaps lead the reader to indicate in further research the various which are mentioned in the present specification covering the different systems and their use.

## The Spad Biplane



CLOSE-UP VIEW OF THE COCKPIT, MACHINE GUN AND MOTOR. SPAD Biplane.



## Digest of the Foreign Aeronautic Press

Aeronautic (London), July 25, 1937

**London to be Struck?**—An editorial dealing with the attitude of the British Government in regard to the German air attack on July 7, on London. A delegation of members of Parliament having waited upon the Prime Minister to urge upon the Government the need for improving the aerial defenses of London, the following editorial reply is published: "I do not want you to go away with any idea that we do not realize the importance of defending London, not merely defending London because it contains millions of people, but because it is the capital of the Empire. I realize that there is a special case for defending London even in comparison with other towns."

"I am on behalf of the Government that we must get the safety of the subjects at the front door, and I am as without any hesitation. . . . A single counter-attack, in France by the Germans on a small scale, produces casualties greater than the whole of the machine destroyed by the machine gun, tank, and aircraft in the air. In the case of London, the loss of the city during the last three years of the war. Do not hesitate but act vigorously."

"One of the treasury's difficulties that once arose, that was brought down. That is a pretty high percentage. It is a much higher percentage than was brought down at the French front line which crossed it or the German line just recently. In that case there were only two out of eighty-five brought down by the Germans, while we brought down four out of twenty-two."

**For Road Grants**—Local relief committees have been appointed in Great Britain for alleviating distress caused by air raids. Advances will be made from the National Relief and Assistance Scheme Funds. The committee has been authorized to grant immediate relief up to an amount equivalent to the rates of the Army assistance allowance, the adopted scale being the following: First and second adult, 34 each, even additional adult, 32 1/2 each, two child, 31 1/2, second child, 31 1/2, third child 30 each, even additional child 29 each. Supplementary allowances are made for maintenance (if the breadwinner has been killed), replacement of articles of furniture and personal effects and also provided for.

Aeronautic (London), August 1, 1937

**Death of a Pioneer**—Another pioneer has disappeared with the death of Wing-Commander Cyril Maudslayi Macfarlane, D.S.O., who was killed on Friday, July 23, at Cramwell in Lancashire. Commander Macfarlane was thirty years of age. He was actively concerned with all the machine-making experiments at the Royal Aircraft Factory, and when the airships were transferred to the Admiralty early in 1934, he joined the Royal Naval Air Service. His pioneer work was connected with machine gun airships in the form of the airship and he was of the greatest service to his country as a pioneer advocate of the airship at a moment when this type of aircraft had fallen into disrepute.

**Attorney-General of Propaganda**—Mr. Haps C. Gibson—At an air dinner, last, two, three or four feet from the eye of the light, mark point A, upon the horizon and B upon the horizon. The angle of elevation of the light (point A) is at some angle to the plane of revolution of the propeller, and it is the angle of which the eye is attached, if the eye is still and the propeller is not revolving through the air. Assuming that the propeller were in a steady operation, a ray from the angle would determine the distance that the waves traveled through the air, while making one complete revolution; and this distance is related to the pitch of the propeller.

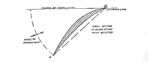
It is in order to determine what is the pitch, proceed as follows:—From a table of tangents, which may be found in any engineering book such as Kryn's, take the tangent of the angle which was measured as indicated. Then form the equation:

$$\tan A = \frac{P}{D} \times \frac{1}{2}$$

where D = the diameter of the circle swept by the points A and B, and P = pitch.

Taking an instance: Mark the points A and B at a radius of 3 ft. from the axis of the propeller hub. Then these points will swing in a circle 6 ft. in diameter, therefore D = 6 ft.

Suppose the angle of the line AB to be at 37° 30' to the plane of revolution, then the tangent of the angle 37° 30' is found from the tables to be 0.7535. Substitute these figures in the equation, which then becomes:



$$0.7535 = \frac{P}{6} \times \frac{1}{2} \quad \text{Therefore } P = 3.3416 \times 6 \times 2 = 39.90$$

$$\text{and } P = 39.91 \text{ ft.}$$

The above procedure can be repeated at each position along the blade, making a new D each time.

TABLE OF TANGENTS FOR THE PROPELLER

Angle (in degrees)	Tangent
37.5	0.7660
37.0	0.7535
36.5	0.7413
36.0	0.7293
35.5	0.7175
35.0	0.7058
34.5	0.6943
34.0	0.6829
33.5	0.6716
33.0	0.6604
32.5	0.6493
32.0	0.6383
31.5	0.6274
31.0	0.6166
30.5	0.6059
30.0	0.5953
29.5	0.5848
29.0	0.5744
28.5	0.5640
28.0	0.5537
27.5	0.5435
27.0	0.5333
26.5	0.5232
26.0	0.5131
25.5	0.5031
25.0	0.4931
24.5	0.4832
24.0	0.4733
23.5	0.4634
23.0	0.4536
22.5	0.4438
22.0	0.4340
21.5	0.4243
21.0	0.4146
20.5	0.4049
20.0	0.3952
19.5	0.3856
19.0	0.3760
18.5	0.3664
18.0	0.3568
17.5	0.3473
17.0	0.3378
16.5	0.3283
16.0	0.3188
15.5	0.3093
15.0	0.3000
14.5	0.2905
14.0	0.2811
13.5	0.2717
13.0	0.2623
12.5	0.2529
12.0	0.2435
11.5	0.2341
11.0	0.2248
10.5	0.2154
10.0	0.2061
9.5	0.1968
9.0	0.1875
8.5	0.1782
8.0	0.1689
7.5	0.1596
7.0	0.1503
6.5	0.1410
6.0	0.1317
5.5	0.1224
5.0	0.1131
4.5	0.1038
4.0	0.0945
3.5	0.0852
3.0	0.0759
2.5	0.0666
2.0	0.0573
1.5	0.0480
1.0	0.0387
0.5	0.0294
0.0	0.0000

The Aeroplane (London), July 25, 1937

**The Production of Aeroplanes and Their Components** By Stephen Balaban—An excellent statement of a thoroughly practical course of the manufacturing and assembling of airplanes.

Flight (London), July 25, 1937

**Scientific Atmospheric Pollution**—An Airman's View—The Air Pollution Pollution has been authorized in London as an act of the Meteorological Office and a grant of £5,000 has been allotted by the Department of Scientific and Industrial Research to carry out the work of the current year.

Flight (London), July 25, 1937

**For Motors**—The problem of how to move the aerial in an aircraft is a problem that will have to be solved sooner or later, says the Sunday Times of London. This will prove particularly necessary in view of the future development of definite aerial and engine motors, which will mean that propellers will have to be replaced entirely by motors in power, but will be rendered impossible aerial rotation.

Now, as an example, the use of a motor will mean that to reduce the freedom of rollers and to enable air fighting to drive the rollers into solid ones, particularly in flight time, while the three question that certain areas must be made, would mean that certain areas must be made in particular directions.

Major Henry Scudder Dies

Major Henry Scudder, head of the Aircraft Engineering Division of the U. S. Army Air Service, died at the Fort Hays, Kansas, after an operation, on August 1. Major Scudder had been ill for about a week, but complications, which developed suddenly, made an operation imperative. He never recovered from the shock, and died a few hours afterward. The funeral was from Forest Hills Chapel, Boston.

He is survived by his wife and two daughters. Major Scudder, whose distinguished career as an engineer made him one of the best-known men in his profession, was born April 15, 1882. His early engineering training was received at the Massachusetts Institute of Technology, where he graduated in 1901. He was engineer for the Pennsylvania Steel Co. for six years, and for six years was with the Pope

and the American Society of Mechanical Engineers, American Society of Testing Materials, Society of Automotive Engineers. He also wrote the Hartford, Boston and New York Engineers.

The Aircraft Board

The Senate Committee on Military Affairs has favorably reported, with amendments, the bill introduced by Senator Sheppard relating the Aircraft Board, to consist of the Chief Signal Officer of the Army, the Chief of Staff of the Navy, and not exceeding five civilian experts.

The bill empowers the proposed Aircraft Board to "supervise and direct, in accordance with the requirements prescribed or approved by the War and Navy Departments, respectively, the purchase, production and manufacture of aircraft, engines and all other and instruments used in aviation therein."

Provision is made by the bill for paying the civilian members of the Board salaries of \$7,500 per annum, and for the employment of technical experts and other necessary employees at salaries to be fixed by the Board.

Senator Chandler, chairman of the Senate Committee on Military Affairs, announced that he would press for immediate passage of the bill, which is regarded as of high importance to both the Departments of War and Navy, and by a Committee of the Aircraft Production Board of the Council of National Defense.

Senator Sheppard, in reporting the bill from the committee, said:

"The Committee on Military Affairs, to which was referred the bill to create the Aircraft Board and provide for its maintenance, hope to report it back with amendments, and amendments that it be amended and passed."

The airplane has become an indispensable and vital weapon in modern warfare. The developments of the present world conflict have demonstrated its overwhelming importance and necessity in connection of those forces. Countries recently appropriated an hundred and forty million dollars for the construction of an air fleet of unparalleled proportions. It is proposed that this fleet should be increased within a year.

This is a task of appalling magnitude. Efforts the maintenance of airplanes in this country has been estimated on an extremely limited scale. The need of a host of experts to operate and maintain these aircraft is a serious problem. The need of the necessary machine, equipment, etc., is apparent. The object of the bill under consideration is the establishment of such a board. The bill has been carefully worked out and has the approval of the Secretary of War, the Secretary of the Navy, and the chairman of the Aircraft Production Board and of the Council of National Defense.

As was known Washington indicates that the bill will probably become a law at an early date.

Bill to Legalize Advance Payments

Another measure of vital importance to aviation has been passed at Washington by Representatives of New York, who introduced into the House a bill to amend the provisions on advance payments, passed by Section 3604 of the Revised Statutes of the United States, or any other act, so they apply to the expenditure of appropriations of money in the bill recently passed authorizing the expenditure of \$10,000,000 for the revenue of the Aviation Section of the Department of Commerce.

Section 3604 prohibits the advance of the public monies on contracts, etc., and the measure now under consideration is designed to permit the War Department to make such advances on contracts and contracts made to enable them to advance their facilities for the production of Government aircraft. Many manufacturers of airplanes not only have valuable designs and patents, but would be in position to turn out a large scale of them had the funds to increase their facilities.

International Standardization Committee

The International Aircraft Standardization Committee, organized by the Allied Governments to effect standardization of the metals relevant into the construction of airplane parts, as well as the parts themselves, held their first meeting in New York August 7. The following attended:



Major Henry Scudder, head of the Aircraft Engineering Division of the U. S. Army Air Service, died at the Fort Hays, Kansas, after an operation, on August 1.

Major Henry Scudder, head of the Aircraft Engineering Division of the U. S. Army Air Service, died at the Fort Hays, Kansas, after an operation, on August 1. Major Scudder had been ill for about a week, but complications, which developed suddenly, made an operation imperative. He never recovered from the shock, and died a few hours afterward. The funeral was from Forest Hills Chapel, Boston.

He is survived by his wife and two daughters. Major Scudder, whose distinguished career as an engineer made him one of the best-known men in his profession, was born April 15, 1882. His early engineering training was received at the Massachusetts Institute of Technology, where he graduated in 1901. He was engineer for the Pennsylvania Steel Co. for six years, and for six years was with the Pope

and the American Society of Mechanical Engineers, American Society of Testing Materials, Society of Automotive Engineers. He also wrote the Hartford, Boston and New York Engineers. The bill empowers the proposed Aircraft Board to "supervise and direct, in accordance with the requirements prescribed or approved by the War and Navy Departments, respectively, the purchase, production and manufacture of aircraft, engines and all other and instruments used in aviation therein."

Frank H. Duffin, late head of the Fire Specialty Co., Chairman of the Committee, representing the United States Government, A. B. Rogers, F. C. Gross and S. G. Paine, C. E. representing Great Britain, Capt. Alexander Pechou and Dr. McElroy, representing Italy, Capt. John H. Hays, Capt. E. S. Chapman and Lieut. M. Sigant, representing France, George L. Norris, representing the Aircraft Engineering Division of the United States Navy, and Dr. George K. Hansen, representing the Bureau of Standards at Washington, and R. W. Zimmerman, of the United States Aircraft Standardization Commission.

Chairman Duffin at the close of the meeting said: "Much results were achieved in the actual meeting. We arrived at definite decisions which will greatly hasten the construction of the thousands of airplanes needed. It is the purpose of the committee to work out the standardization of metal steel, and then to work rapidly for the same result in every detail of airplane construction. The effect of this will be to increase production. The results to be obtained by such quality production are what the Allies are looking for—the supremacy of the air, which is destined to decide the outcome of the war."

#### Manufacturers' Aircraft Association

At a special meeting of the Manufacturers' Aircraft Association, held August 8, Samuel H. Bradley, a harness man at Brooklyn, was named general manager of the Association. Frank H. Roach, president of the Association, explained that the mission of this new office was considered desirable by several of its members, the Association, and the fact that important questions in connection with standardization and materials were routinely coming up between Army and Navy officials and members of the Association, necessitating a more extensive and continuous contact between the Association and the departments at Washington. It was also felt that the appointment of Mr. Bradley would be made to further questions of material and eliminate delays which have been heretofore caused by lack of a direct representative of the Association at Washington, where Mr. Bradley will spend most of his time.

#### Navy Will Build Aircraft Factory

The construction of an aircraft factory at the League Island Navy Yard, Philadelphia, Pa., has been authorized by the Secretary of the Navy. In making the announcement of the new plant, Secretary Daniels said:

"As one of the enormous expansion of the airplane industry now being undertaken in the United States, it was felt that it was necessary to increase the Navy Department's facilities along these lines, not only to enable it to supply a part, at least, of its own needs, but in order that the private plants might be relieved of the experimental developments which they have heretofore undertaken and to thereby attract attention to the maximum production of approved types."

Contracts have been placed for the factory on the basis of completion of buildings and beginning of operation in less than 180 days. The total cost of the building and plant will be in the neighborhood of \$1,000,000, and it is expected that when the completed plant is working up to its capacity it will utilize the services of approximately 2,000 employees and be capable of producing 1,000 small machines per annum, or a corresponding output of the larger types.

The Navy Department has a small flying field at the League Island Yard adjacent to the factory, and expects the facilities for airplanes, so that it will be able to utilize this plant to keep the Navy in the forefront with the latest developments in aircraft.

#### Stops Export of Airplanes

The Export Control, recently appeared under authority of the Act of Congress to restrict export of goods from this country, has issued an order prohibiting the export of airplanes and airplane engines without special permit from the Government.

In explanation of the order, it was stated that many neutral countries were having airplanes in considerable quantities in the United States, and as it was considered necessary in the public interest that American machines be used in the prosecution of the war, it was deemed to stop the sending of machines out of the country unless by special permit.

#### Names for Army Flying Fields

The War Department announces that the flying field at Marshall, L. I., has been named Bloodgood Field, and that San Diego, Cal., Rockwell Field and at Bethesda, Md., Ross Field.

The field at Fort Sam Houston, near San Antonio, Texas, will be known as Camp Kelly, and incident will design the different units.

#### Examinations for Aeronautical Draftsmen

The United States civil service commission will hold an open competitive examination for appointment as Government aeronautical draftsmen.

The examination is open to men only. The duties require the services of draftsmen who are experienced in drafting from automobile or aircraft layouts or machinery drawings. Salaries range from \$4,200 to \$14,400 a year.

The commission anticipates the need of a great number of such men when America begins construction of her airplane air fleet, will receive appointment as civil engineer and further notice. Forms for application may be secured from the civil service commission, Washington, or any of its branches.

#### To Teach Aeronautical Engineering

Frank Edward McKinnis, a graduate of the Massachusetts Institute of Technology, and at present Federal inspector at the Curtiss Aeroplane and Motor Corporation, has been appointed assistant professor of mechanical engineering at the University of Washington, Seattle, Wash. He will have charge of the instruction in aeronautical engineering.

#### New Aircraft Companies Formed

The Journal of Commerce (New York) prints the following list of new companies organized since the first of this year, of which 35 will manufacture aircraft and its accessories:

	JANUARY 1917
National Aircraft Corp., N. Y.	\$172,000
Aviation Motor Corp., N. Y.	100,000
Wing-Wing Aircraft Co., Dayton	100,000
<b>Total</b>	<b>\$372,000</b>
	MARCH 1917
Federal Aircraft Corp., Baltimore	\$100,000
General Aircraft Corp., New York	100,000
Aviation Motor Corp., N. Y.	100,000
<b>Total</b>	<b>\$300,000</b>
	APRIL 1917
Aviation Motor Corp., N. Y.	\$100,000
General Aircraft Corp., New York	100,000
Aviation Motor Corp., N. Y.	100,000
General Aircraft Corp., N. Y.	100,000
<b>Total</b>	<b>\$400,000</b>
	MAY 1917
American Aircraft Corp., N. Y.	\$100,000
Aviation Motor Corp., N. Y.	100,000
General Aircraft Corp., N. Y.	100,000
Aviation Motor Corp., N. Y.	100,000
<b>Total</b>	<b>\$400,000</b>
	JUNE 1917
American Aircraft Corp., N. Y.	\$100,000
Aviation Motor Corp., N. Y.	100,000
General Aircraft Corp., N. Y.	100,000
Aviation Motor Corp., N. Y.	100,000
<b>Total</b>	<b>\$400,000</b>
	JULY 1917
American Aircraft Corp., N. Y.	\$100,000
Aviation Motor Corp., N. Y.	100,000
General Aircraft Corp., N. Y.	100,000
Aviation Motor Corp., N. Y.	100,000
<b>Total</b>	<b>\$400,000</b>



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The lubrication of an aeroplane motor, because of its very function, should be one of a problem, that the lubrication of an automobile motor.

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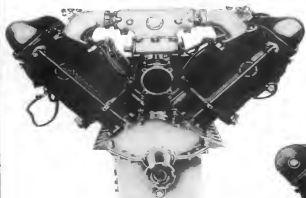
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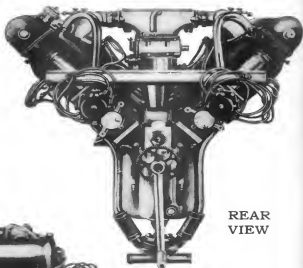
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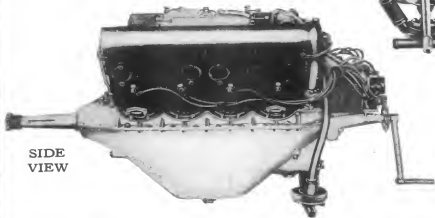


FRONT  
VIEW

*DEVELOPS 150 H. P.  
AT 1450 R. P. M.*



REAR  
VIEW



SIDE  
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